**What Would You Think?**

**Transforming Observations into Hypotheses**

**(Do NOT Write on This Paper)**

Coming up with hypotheses is central to the way that scientists work. Do spiders hear with their legs? Spiders jump in response to a loud noise. If their legs are cut off, they no longer respond this way. Therefore spiders must hear with their legs.

Of course, the above example is a joke. But it does illustrate a process at the heart of science. A ***hypothesis*** is put forward to explain something. The hypothesis put forward here is consistent with what happens. But there is not much other evidence to support it. Not many animals use their legs for hearing. And there are other possible explanations (the obvious one being that a legless spider will not jump under any circumstances).

In science, a hypothesis may be challenged. A good hypothesis makes ***predictions,*** which can be tested. For example, if a spider really did have hearing organs on its legs, it should be possible to see them. Or someone might suggest an alternative theory, also consistent with the original finding. Further experiments might reveal which was more likely to be correct. Over time, a hypothesis might therefore be adapted or, if shown to be completely wrong, thrown away entirely.

If a hypothesis is particularly powerful, and illustrates a wider principle, it might become a ***theory.*** Although the two terms mean much the same thing in everyday speech, in science they are subtly different. A hypothesis is an early suggestion, quite likely to be overthrown or adapted over time. A theory is well established, is supported by several lines of evidence and applies over a broader area.

**Hypotheses and theories have things in common:**

* they can explain an observation or experiment.
* they make predictions that can be tested, so they can be shown not to be true (falsified).
* they are not set in stone but can be refined or rejected over time.
* they should also make a minimal number of assumptions about unknowns.

**Charles Darwin’s work can illustrate the difference between the two:**

* A Darwinian hypothesis: that Darwin’s finches on the Galapagos Islands originated from a single species and diverged to fill different ecological niches (adaptive radiation).
* A Darwinian theory: new species are formed from existing species through the action of natural selection.

**Activity**

In this activity you will practice the process of hypothesizing – coming up with reasonable explanations for a set of mysterious observations. As you find out more, you will have a chance to revise or discard your hypothesis.

You have hitched a ride on a ship (the *Beagle*) destined to chart the South American coast and check longitudes around the world. As a science student, you will be making observations and collecting data on life in unexplored parts of the world. You will uncover many interesting things and do the best you can to explain the things you observe.

1. Read the first two observations recorded in your journal of the trip. On the basis of what they say, come up with a hypothesis to explain the following:
   1. Why do the tortoises look the way they do?
   2. Decide how confident you are that you have the right answer. A lower score would mean you are not sure you are right and a higher score would mean that you are fairly certain.
   3. On a **separate sheet of paper**, create a chart like the one below and record your hypotheses.

|  |  |  |  |
| --- | --- | --- | --- |
| Hypothesis 1 |  | Confidence Level (0-100) |  |
| Hypothesis 2 |  | Confidence Level (0-100) |  |
| Hypothesis 3 |  | Confidence Level (0-100) |  |
| Final Hypothesis |  | Confidence Level (0-100) |  |

1. Read the next two journal entries. Again, think about whether the new information you have received is consistent with your hypothesis or whether it contradicts your hypothesis. Also think about whether other hypotheses might explain the observations better.
2. Rewrite your hypothesis, and assign a number to describe how confident you are in it.
3. Repeat steps 2 and 3 for journal entries 5 and 6.
4. Now read the final two journal entries. Again, think about whether this information is consistent with your hypothesis. Look at all the evidence you now have from the entries and decide what your final hypothesis is going to be.
5. Write your final hypothesis in the chart you created, and indicate how confident you are in your conclusions.
6. On a **separate sheet of paper**, answer the following questions regarding this activity:
   1. How easy was it to think up hypotheses initially?
   2. How easy was it to decide between competing hypotheses?
   3. How did you choose between them?
   4. How did the extra evidence help you?
   5. Did it make it easier to think up hypotheses? Give an example.
   6. Did it help you eliminate hypotheses? Give an example.

Adapted from:

British Council Darwin Now “Hypothesis” activity (http://darwin.britishcouncil.org/activities/hypothesis-age-16-19)

# California Academy of Science “Connected Experience: Evolution and the Galapagos Tortoise” lesson (http://www.calacademy.org/teachers/resources/lessons/evolution-and-the-galapagos-tortoise/)